THE MISSOURI WASTE COMPOSITION STUDY

MUNICIPAL SOLID WASTE

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MUNICIPAL SOLID WASTE
Phase I
1996

Phase II
1997

Conducted by:
MIDWEST ASSISTANCE PROGRAM, Inc.
The Midwestern Rural Community Assistance Program

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THE MISSOURI DEPARTMENT OF NATURAL RESOURCES

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Project Manager.....Dennis Siders
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Chapter 1: Introduction

What is a waste composition study?

Solid waste management is one of the most pressing environmental problems that we face today. Our solid waste is rapidly filling up available disposal space, and in some areas causing a disposal crisis. One way to remedy this problem, and in the process conserve our natural resources, is to reduce, reuse, or recycle some of that solid waste. To do this, information is needed on the solid waste stream in order to target waste reduction efforts and programs.

The Missouri Waste Composition Study analyzed the composition of the municipal solid waste (MSW) stream throughout the state. Municipal solid waste includes trash from residential, commercial, and institutional sources as well as small generators of industrial trash. By identifying the components of the trash, and their percentage within the municipal waste stream, programs can be designed and implemented to reduce, reuse, or recycle targeted materials.

What are some previous and related composition studies?

A number of waste composition studies provide MSW information for national, state, or local levels of government. The most notable study on waste composition is *The Characterization of Municipal Solid Waste in the United States,* conducted annually by the Franklin Associates, Ltd. These reports (released by the Environmental Protection Agency) characterize the national waste stream based on various data accumulated since 1960. The methodology used is based on production data (by weight) for the materials and products in the waste stream, with adjustments for imports, exports, and product lifetimes. The results of these studies are used to evaluate current solid waste generation in comparison to past years, and also to project future waste generation rates.

In 1987, the Missouri Environmental Improvement and Energy Resources Authority (EIERA) published the *Statewide Resource Recovery Feasibility and Planning Study*. This study included two seasonal waste sorts at four representative sites around Missouri. The study was the first of its kind in Missouri and established a baseline for further composition studies. One result of the EIERA study was the passage of Senate Bill 530 in 1991.

Two Solid Waste Management Districts, Region D and the Ozark Rivers Solid Waste Management District, have conducted their own waste sorts. Reported findings differed considerably from the 1987 EIERA Study.

Other states have also conducted waste characterization studies. Two studies in particular *The Minnesota Solid Waste Composition Study 1990-92* and *Wisconsin's Solid Waste Composition Manual 1993*, were used as guidelines for planning the *Missouri Waste Composition Study*. Other state composition studies include those from Rhode Island (1990), Michigan (1989), New York (1991), Ohio (1991), Oregon (1992-93), South Dakota (1991), and West Virginia (1991).

Why is it important?

There are many reasons why waste composition studies are performed. The information:

- Provides accurate baseline data needed for solid waste planning and reduction efforts at all levels of government.
- Can be used for planning waste reduction programs and targeting recyclable material available for marketing.
- Can be used to measure the effectiveness of current waste reduction programs.
- Provides needed information for the creation and implementation of future solid waste legislation.
- Can be used by private and municipal recyclers to plan material flows, capacities, revenues, and operating expenses.

National waste characterization studies provide general estimates and predictions of the waste stream, but do not take into consideration specific factors which make the Missouri waste stream different from other regions in the United States. It is also very likely that the results found in the 1987 EIERA study are no longer representative of the current waste stream generated in Missouri. A more encompassing waste study is important in understanding the current composition of Missouri's waste stream and the possibilities for continued waste reduction activities.

Comparisons between the findings in this study and previous studies are examined in Chapter 13. These comparisons show that there has been a change in the composition of the Missouri waste stream since the 1987 EIERA study and differences between other states and the 1994 Franklin and Associates study.

What are the Missouri waste reduction laws and goals?

In 1990, the Missouri General Assembly passed Senate Bill 530. This bill contained legislation pertaining to landfill permitting requirements, set state wide goals for solid waste recovery and reduction, banned certain items from Missouri landfills, set up a solid waste management fund and provided for the development of Solid Waste Management Districts.

The goal set by Senate Bill 530 was a 40% reduction in the statewide waste stream by January 1, 1998. To accomplish this, certain materials were banned from solid waste disposal areas. These products included major appliances (white goods), waste oil, whole tires, lead-acid batteries, and yard waste or clippings. To help meet the waste reduction goal emphasis was placed on reduction and recycling activities at state and local levels of government.

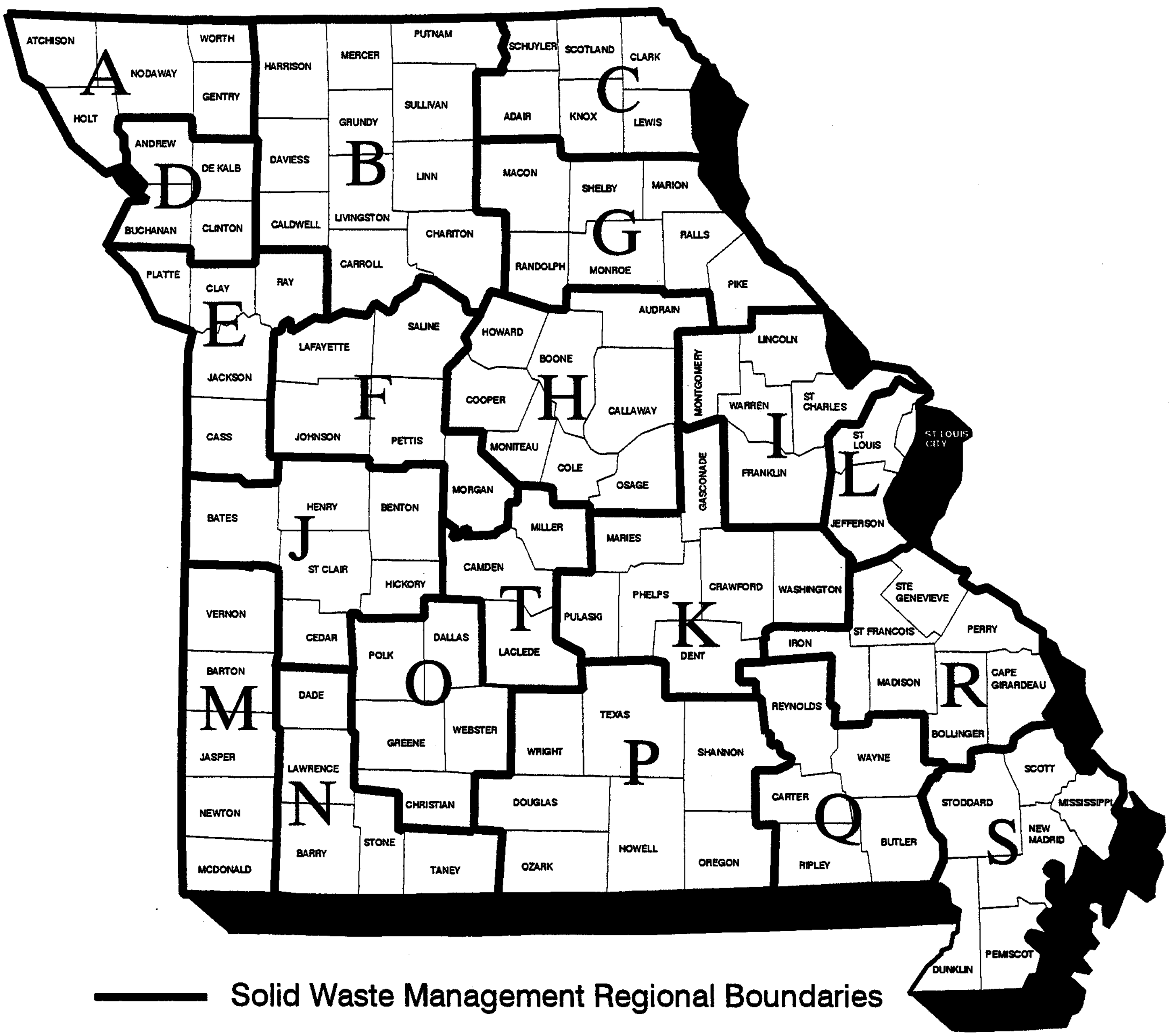
As a result of Senate Bill 530, 20 Solid Waste Management Districts were formed with 113 counties participating. Each District provides technical assistance on solid waste practices and is responsible for assessing solid waste activities within the District. Each assessment is required to have a waste stream analysis for that solid waste management district. A map of the Missouri solid waste management districts is on page 5.

How was the Missouri waste composition study funded and implemented?

The Missouri Waste Composition Study was funded through a statewide project grant from the Missouri Department of Natural Resources (MDNR). The Midwest Assistance Program (MAP) developed and implemented the study. MAP is a non-profit organization which provides environmental technical assistance throughout the Midwest. During Phase I (1996), MAP conducted 29 waste sorts in ten solid waste management districts throughout the state. Three sorts were conducted at each site (one sort was canceled due to poor weather conditions).

During Phase II (1997), 27 additional waste sorts will be conducted in the nine remaining districts (the University of Missouri at Columbia is conducting a separate waste study for the 20^{th} district). Waste sorts conducted during both Phase I and II will only examine municipal solid waste. Industrial waste, construction and demolition waste, and special waste streams are not included in this study. The methodology used for this study is discussed in Chapter 2.

SOLID WASTE MANAGEMENT REGIONS OF MISSOURI



Solid Waste Management Regional Boundaries

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
SOLID WASTE MANAGEMENT PROGRAM

Chapter 2: Methodology

Introduction

A waste composition analysis is very useful for planning effective solid waste management and recycling programs. Recycling collection, processing, and storage capacities, as well as operation budgets and revenues are all based on estimates of available materials in the waste stream. Therefore, the need for accuracy and statistical relevance in data collection is very important. These aspects were considered when determining the methods, procedures, and statistical analysis to be used for this study. After careful examination of several statewide waste composition studies, the *Minnesota Solid Waste Composition* study was chosen a model for planning the study. SPSS statistical analysis procedures were used to check statistical relevance of the data and will be discussed later in this chapter.

Selection of waste to be analyzed

For both Phase I and II of the *Missouri Waste Composition Study*, only municipal solid waste (MSW) was examined. According to the EPA's *Characterization of Municipal Solid Waste in the United States: 1994 Update,* MSW can be broken down into five main categories:

- Durable goods (appliances)
- Nondurable goods (newspapers, magazines)
- Containers and packaging. (bottles, cans)
- Organic waste (food scraps and yard trimmings)
- Inorganic wastes (pet litter, dirt)

For the purposes of this study, waste samples did not include wastes from other sources, such as construction and demolition wastes, bulky items, sewage sludge, combustion ash, or industrial process waste. In order to provide consistency throughout the study, only residential waste (single and multi-family dwellings) and light commercial waste (retail businesses, offices, restaurants, institutions, etc.) were selected as the target waste streams for this study. The MSW stream is the target for most municipal and private recycling programs and is normally collected in small containers or plastic garbage bags by municipal or private waste haulers. Bulky items and large durable goods were also excluded due to difficulties in assuring random selection and problems in transportation of the samples to the sorting area. The sampled bagged waste is not the entire waste stream, but it is the largest single component of MSW.

Selection of sorting sites

MAP and the planning staff at MDNR developed criteria used to select waste sort locations. Two main objectives were to select locations that were representative of the waste within that particular district, and to select locations which could be used as a guide for cities outside the district with similar characteristics. In this way, other locations in Missouri could use the data by selecting the site most similar to their demographics. A map of Missouri landfills is on page 9. A map of transfer stations is on page 10. The following locations were selected for Phase I:

City of Springfield Landfill	Teeter's Landfill in Macon
Reeds Spring Transfer Station	City of Maryville Landfill
Pemiscot County Transfer Station	City of Lee's Summit Landfill
St. Francois County Transfer Station	Ellis Scott Landfill in Clinton
City of St. Louis Transfer Station	BFI Landfill in Lamar

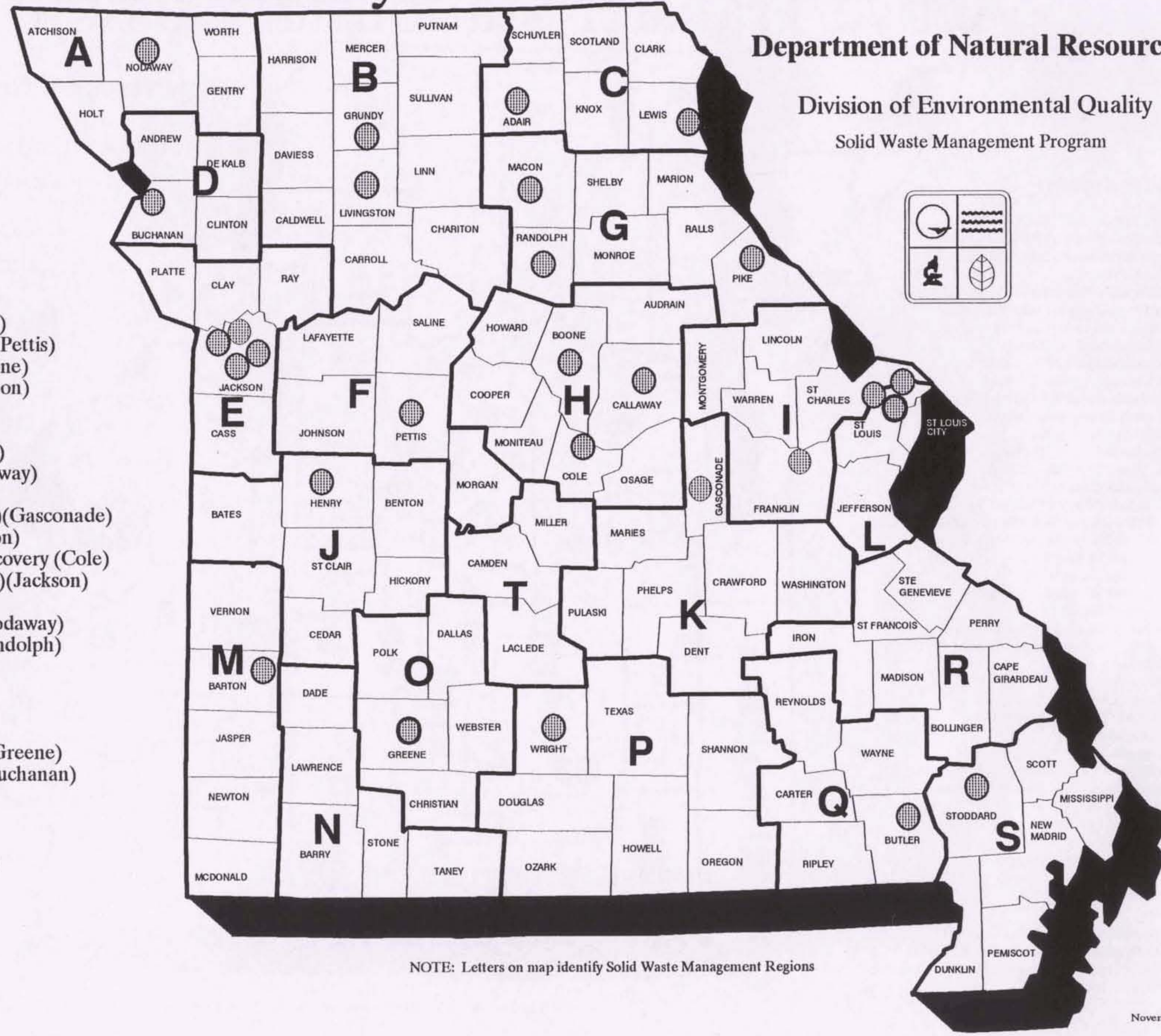
Chapters 3 to 12 describe the sort locations and provide the data from those waste sorts.

Active Sanitary Landfills of Missouri

Department of Natural Resources

Division of Environmental Quality

Solid Waste Management Program



FACILITY (COUNTY)

1. BackRidge (Lewis)
2. Black Oak (Wright)
3. Butler County (private)
4. Central Missouri Inc. (Pettis)
5. City of Columbia (Boone)
6. Courtney Ridge (Jackson)
7. Ellis Scott (Henry)
8. Farmer's (Livingston)
9. Fred Weber (St. Louis)
10. Fulton (City of)(Callaway)
11. Henderson (Grundy)
12. Kahle (Cedar Hollow)(Gasconade)
13. Lamar (City of)(Barton)
14. Land & Resource Recovery (Cole)
15. Lee's Summit (City of)(Jackson)
16. Lemons (Stoddard)
17. Maryville (City of)(Nodaway)
18. Moberly (City of)(Randolph)
19. Northside (Franklin)
20. Rumble (Jackson)
21. Rye Creek (Adair)
22. Southeast (Jackson)
23. Springfield (City of)(Greene)
24. St. Joseph (City of)(Buchanan)
25. Superior (St. Louis)
26. Sutton & Sons (Pike)
27. Teter (Macon)
28. West Lake (St. Louis)

NOTE: Letters on map identify Solid Waste Management Regions

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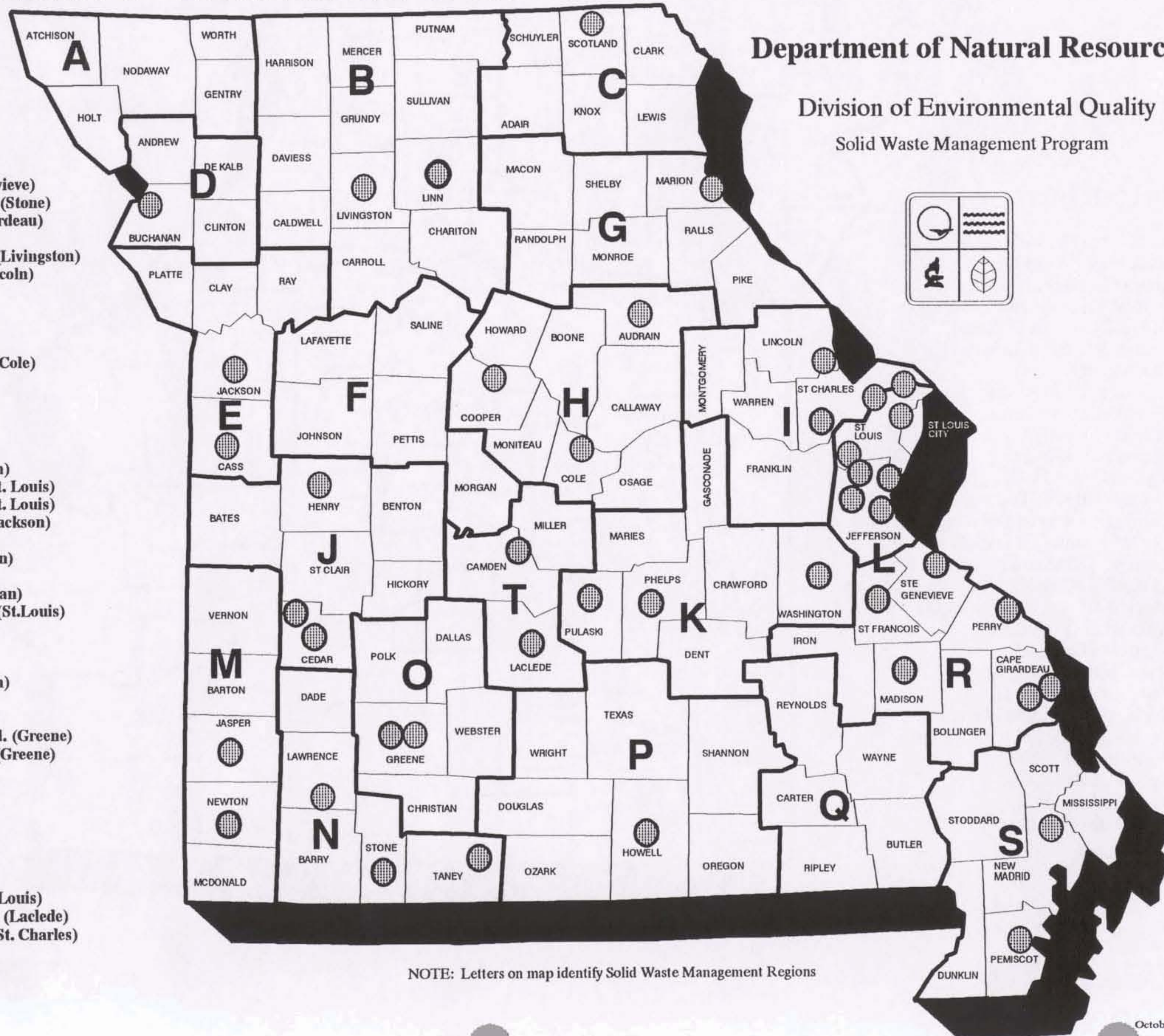
November 13, 1996

Active Transfer Stations of Missouri

Department of Natural Resources

Division of Environmental Quality

Solid Waste Management Program



NOTE: Letters on map identify Solid Waste Management Regions

FACILITY (COUNTY)

1. CWI of Missouri (Ste. Genevieve)
2. American Disposal Services (Stone)
3. Cape Girardeau (Cape Girardeau)
4. Cass County
5. Chillicothe Municipal Util. (Livingston)
6. Christian Disposal Inc. (Lincoln)
7. City of Boonville (Cooper)
8. City of Mexico (Audrain)
9. Clinton Municipal (Henry)
10. El Dorado Springs (Cedar)
11. Environmental Sanitation (Cole)
12. Fredericktown (Madison)
13. Gilliam (Washington)
14. J.T. Brown Ent. (Marion)
15. Jackson (Cape Girardeau)
16. Jefferson County
17. Kraemer Hauling (Jefferson)
18. Laidlaw-St. Louis-North (St. Louis)
19. Laidlaw-St. Louis-South (St. Louis)
20. Longview of Kansas City (Jackson)
21. M. S., Inc. (Camden)
22. Meramec Hauling (Jefferson)
23. Neosho (Newton)
24. Norris & Son, Inc. (Buchanan)
25. North American Recycling (St.Louis)
26. Pemiscot County
27. Perry County
28. Phelps County
29. Reliable Disposal (Jefferson)
30. Scotland County
31. Sonny's (New Madrid)
32. Springfield City Refuse, Ltd. (Greene)
33. Springfield Relay Systems (Greene)
34. St. Francois County
35. St. Robert (Pulaski)
36. Stockton Lake (Cedar)
37. Sunray Services (Jasper)
38. Taney County
39. Tate's (Lawrence)
40. Teter (Linn)
41. University City Refuse (St. Louis)
42. Waste Mgmt. of the Ozarks (Laclede)
43. Waste Mgmt. of St. Louis (St. Charles)
44. West Plains (Howell)

swmp\kt\ts map

October 8, 1996

Selection of seasonal sorting dates

Waste streams can change considerably during different times of the year. Tourism, growing seasons, and temperature changes can all play a factor in the quantity and composition of a waste stream. This study wanted to account for this change by conducting seasonal sorts. Sorting dates were scheduled so that each site would have three seasonal sorts: first round (February-April), second round (May-July), and the third round (September-November). Each sort was scheduled to last three days. Since the types of MSW generated during and immediately after holidays tend to be different from MSW generated during other times of the year, sorts were not scheduled between mid November and mid January.

Selection of sorting categories

In selecting sort categories MAP and MDNR reviewed previous waste composition studies, analyzed recycled material markets, and consulted with several solid waste planners. Sort categories were selected based on the following criteria:

- Consistent with other state and federal studies for comparison purposes.
- Present in most samples of MSW.
- Specific enough to help with the evaluation of recycling and reduction potential.
- General enough to be able to sort samples in a reasonable period of time
- Convenient and practical for random selection and transportation to and from the sort facility.

The following pages contain a list of categories and sub-categories selected for this study.

PAPER

Cardboard and Kraft Paper- Non waxed corrugated cardboard (OCC) box board, and Kraft paper. Examples: corrugated boxes, cereal boxes and grocery sacks.

Newsprint-. Printed groundwood paper. Examples: newspapers and glossy advertisements typically found in newspapers.

Magazines- Periodicals, or bound printed material that is intended to be discarded after a certain date. Examples: glossy magazines, catalogs and phone books.

High Grade Paper- Paper that is recyclable and consistently has a positive market value (normally found in offices). Examples: bond computer paper, index cards, notebook paper, xerographic and typing paper, yellow tablets, manila file folders, fax paper and white cash register receipts.

Mixed Paper- All paper that does not fit into the categories specified above (Newsprint, High Grade Paper, Cardboard and Kraftpaper, and Magazines). Examples: construction paper, books, tissue paper, waxed paper, carbon paper, non-corrugated paperboard, groundwood computer paper, paper with tape or adhesives, envelopes with windows, paper cups, paper plates and tablets with colored glue binding.

GLASS

Clear Glass Containers- Clear glass which originally contained food or beverage. Examples: primarily soft drink and food containers, clear beer containers.

Brown Glass Containers- Brown glass which originally contained food or beverages. Examples: containers for beer, light-sensitive chemicals and drugs.

Green and Blue Glass Containers- Green or blue cast glass which originally contained food or beverage. Example: soft drink and wine containers.

Other Glass- All glass that was not originally a food or beverage container and glass broken beyond recognition. Examples: window glass, mirrors, light bulbs, windshields, fragrance bottles and fragments.

METALS

Aluminum Cans- All aluminum beverage containers.

Other Aluminum- All aluminum except beverage containers. Examples: aluminum foil, aluminum lawn chairs, aluminum wrappers and all other recognizable aluminum.

Ferrous Food Cans- Any steel food containers, including ferrous pet food cans. (Empty aerosol cans and empty paint cans were also included in this category).

Other Ferrous- Ferrous and alloyed ferrous scrap to which a magnet attracted. Examples: some metal appliances, wire hangers, commercial or industrial products, nuts and bolts, electrical motors.

Other Non-Ferrous- All nonmagnetic metals that are not recognizable as aluminum.

Oil Filters- Used and new oil filters for automobiles.

PLASTICS

PET (#1)- Beverage bottles composed of polyethylene terephthalate with or without an HDPE base cup. Also includes other containers clearly labeled PET (#1). Examples: pop bottles, some dishwashing soaps, honey, liquor and toiletries.

HDPE (#2)- High density polyethylene containers. Examples: jugs and bottles for detergent, dairy products, windshield fluid containers, some medicine containers, motor oil and shampoo.

Plastic Film- Includes all flexible plastic film regardless of resin content. Examples: garbage bags, bread bags, snack bags, plastic grocery bags, food wrappings and shrink wrap.

Other Plastic- Includes: PVC (#3), LDPE (#4), PP (#5), PS (#6), other plastics or mixed resins (#7), and unidentifiable plastics. Examples: plastic bottle caps, 6-pack rings, brick pack juice boxes, squeezable bottles, individual condiment containers, dairy tubs, mouthwash bottles, styrofoam and blister packs.

ORGANICS

Food Waste- Putrescibles. Material capable of being decomposed by microorganisms with sufficient rapidity as to cause nuisances from odors and gases. Examples: kitchen waste, other food, waste parts from butchered animals and dead animals

Wood Waste- Includes wooden furniture, wooden tool handles, boards, plywood and particle board.

Textiles- All woven fabric, natural or synthetic, either in bulk or made into usable items. Examples: clothing, carpet, curtains, linens, rugs, canvas bags and fabric.

Disposable Diapers- Adult or infant disposable diapers, clean or soiled.

Other Organics- Those items which do not fall into any other category and which are composed of carbon-based material. Carbon-based material includes those items made of natural substances which, when left exposed to the natural elements, would eventually decompose. Examples: leather, rubber, baskets, furniture of willow or bamboo, hair, shoes, feminine protection items, cotton balls, and inseparable organic composite items.

INORGANICS

Fines- All matter not sorted into specific categories which are too small or mixed to be categorized. Usually the remaining remnants of the sort. Examples: coffee grounds, rocks, dirt, ceramics and kitty litter (clay), cigarette butts, small bits of paper, and dirt.

Other Inorganics- Those items which do not fall into any other category and which are composed of inert materials which would not decompose when left exposed to the natural elements.

Items that were considered unusual or possibly hazardous were kept apart from the above categories. At the end of each sort, these items were collected on a table and listed separately from the regular data. Most of these items could be grouped together into sub categories. Listings of these items found during each sort are located in later chapters. The following list describes the types of items found in the sub categories:

OTHER WASTE

Over-the-Counter Medicine (OTC)- Medication bought over the counter. Examples: vitamins, antacid, aspirin, cold medicine.

Prescription Medication (Rx)- Medication requiring a prescription. Examples: oral contraceptives, prescription inhalants, perspiration ointments, vaccinations (human or animal).

Beauty/hygiene products- Items used for cosmetic or hygiene purposes. Examples: soap, shampoo, cosmetics, hair gel, deodorant, toothpaste, mouthwash, perfume/cologne, etc.

Beauty/hygiene aerosol products- Items in an aerosol can used for hygiene purposes. Examples: shaving cream, hair spray, deodorant.

Household cleaning products- Products used for cleaning items in a household. Examples: silver cleaner, floor wax, furniture oil, all-purpose chemical cleaners, bleach, dishwashing detergent, etc.

Household cleaning aerosol products- Products used for household cleaning in aerosol containers. Examples: furniture polish, oven cleaner, some glass cleaners, etc.

Aerosol Cans- Aerosol cans containing product. Examples: spray paint, some glues, air freshners.

Sharps/Blades- Items with sharp edges that could cause harm if handled improperly. Examples: knives, blades from utility knives, saws.

Syringes and Needles

Hardware/Shop products- Items used for home improvement projects or building projects. Examples: rubber cement, caulking, wood stain, paint thinner, glue.

Gardening/Yard products- Items used for garden and lawn care and maintenance. Example: pesticides, plant food, garden chemicals, water treatment chemicals.

Disposable razors

Alkaline batteries

Miscellaneous items- Unusual items which could be harmful or toxic but do not belong in any of the above categories. Items will be listed separately for this category.

Procedure for selecting loads

Prior to conducting a sort, MAP staff consulted with the district planner and the facility manager of each site for their input into the type of waste received at the facility. All samples were taken from licensed local trash haulers who served residential and commercial customers. MAP staff did not sample waste from roll-off containers, transfer trailers, homogeneous industrial waste, construction and demolition wastes, bulky items, and toxic or special wastes.

Waste haulers entering the landfill or transfer station were chosen at random and interviewed to determine eligibility of their load. If the load met the sampling criteria listed above, the driver was asked to identify his company, the geographical origin of the waste, and the estimated percentage of residential and light commercial waste.

Procedure for selecting samples

After the hauler emptied their load, the MAP project manager selected a sample. Research from various waste analysis studies indicated that the size of a sample should be between 200 and 250 pounds. Normally 20 to 25 bags of waste would satisfy the weight criteria. Random selection was accomplished by taking bags from all sides of the pile after it was unloaded by the waste hauler. The MAP project manager selected every sample from every sort. This provided consistency and insured random selection throughout phase I. Each sample was sorted, weighed, and recorded separately on the data sheet used to interview the waste hauler. Other factors recorded on the data sheet included weather conditions, sorting conditions, and unusual materials found in the sample. Only one sample was taken from each selected hauler except at low traffic sites. The sample was loaded onto a trailer and transported to the sort area.

For the first round of sorts, 14 to 16 samples were collected at each site. However, only 12 samples were collected at each site during the second and third round of sorts. Statistical evaluation revealed that the number of samples needed could be lowered from 16 to 12 while still maintaining statistical relevance.

Sorting Procedure

A sorting tent was set up at each site to provide shelter from the weather during the sorting process. The sort facility consisted of a 12-person military tent used to house equipment and tables. General equipment used during the sorts included category containers (20 gallon garbage containers), personal protective equipment (gloves, tyvek suites, boots, masks, etc.), portable heaters and/or fans, lights, a portable electric generator, tools used for sorting (linoleum knives, hand cultivators, shovels, brooms, etc.), and a portable scale used for measuring the weight for each category.

Temporary workers were hired at each site to assist with the sort. The sorters were required to attend a training class (taught by the MAP sort supervisor) prior to the sort. During this class sorting procedures, types of waste categories, and safety guidelines were explained. Personal protective equipment for each sorter (tyvek suites, neoprene gloves and cotton liners, and steel-toed boots) was provided by MAP and was required garb during sorting activities.

First Round Procedure

The following procedure was used for the first round of sorts. The sample was selected, and transported to the sort facility which was set up as close as possible to the tipping area. Two sorting tables were set up adjacent to the tent with a sample placed on each table. The entire sample was pre-sorted by the project manager and the sort supervisor. Pre-sorting (emptying all the bags on the sorting table to scan the contents) was performed to remove any potentially hazardous materials before normal sorting procedures began. The presorting proved to be an unnecessary step.

Once pre-sorting was completed, the sorters would begin by placing the waste into its assigned category container. When sorters came across items belonging in the "Other Waste" category, they would alert the sort supervisor, who removed it from the table. The entire sample was separated and the materials were placed into the appropriate containers. The "fines" were swept to the end of the table and collected. The containers were weighed, the weight and estimated volumes for each category were recorded on the data sheet. Once the categories were measured and recorded, the containers were carried back to the tipping area or emptied into a large dumpster provided by the operating facility. This procedure was repeated, one sample at a time, until all samples had been categorized, weighed, and recorded.

All waste was sorted into identical 20 gallon plastic containers which weighed 5.5 pounds each. An *accu-weigh* top loaded spring scale was used to weigh all containers. The volume of each container was approximately 3 cubic feet. Volume estimates were recorded when each container was weighed.

Second and Third Round Procedure

The following modifications were made to the sorting procedure after the first round of sorts. The number of samples for each site was reduced from 16 to 12 and only one table was used for sorting purposes, reducing the number of sorters needed for each sort from four to two. This lengthened the sorting time at each site but increased the accuracy. The sorting tent was set up away from the tipping area and a trailer was added to transport samples to and from the sorting tent. This provided a safer and more protected environment for the sorting crew.

Presorting was eliminated because very little dangerous materials were found in the first round and wind gusts blew lighter materials off the table. During the second and third rounds, sorters were instructed to open one bag of the sample at a time and sort the waste directly from the bag, into the appropriate containers, until all the contents were categorized. When one bag was finished, the sorter would pick another bag from the sample and continue with the same sorting procedure until all bags from that sample were sorted. A safety demonstration was added to the training session to show sorters how to correctly sort from the bag. These changes in the sorting procedure made sorting activities cleaner, more accurate, and more efficient. These changes were used for all sorts conducted during the second and third rounds.

Statistical Relevance

In addition to the concerns for random sampling and accurate data collection, there is also a need to show how relevant the sample means were to the actual population means. For each sample taken, the total weights (in pounds), estimated volumes (in cubic feet), mean (average) weight and volume, and the percentage of weights and volumes for each category and subcategory were calculated. By using these figures, statistical significance and relevance were calculated for each sort.

Using an SPSS statistical program, the data from each category and subcategory was converted into percentages of the total weight. These percentages were then used to calculate statistical significance and confidence intervals for each site overall. The confidence level for this study was set at 95%. This means that there is a 95% chance that the randomly selected samples will fall within a certain range.

The significance test was also calculated for each category and subcategory. Statistical significance showed the likelihood that the sample means were close enough to the actual population means to make inferences about its composition. For this study, significance was achieved if the significance test yielded a probability of .05 or less. All samples examined during Phase I proved to be significant. This means that there is a 1 in 20 chance (or less) that a random sample will not fall within the actual population mean.

The statistical results for each sort and the summary of statistical results for each location are listed in each chapter. Statistical results include:

- The estimated weight of MSW that was collected at the site during the sampling period.
- The total pounds sampled during each sort.
- The total number of samples collected.
- The significance results.
- Mean sample, in pounds, and confidence interval at the 95% level (summary results only).

The mean weight for all samples fell within the 95% confidence level and are significant. The margin of error varied between 2-7% dependent on the material sampled and the sample size. This data is available upon request from MAP.